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QUALITY ASSURANCE PROJECT PLAN

FOR EVALUATING STORMWATER MANAGEMENT PROJECTS IN THE YUBA WATERSHED

Revision 1.0

Refer correspondence to:
Gary Reedy
South Yuba River Citizens League (SYRCL)
216 Main Street
Nevada City, CA 95959

Approvals:

State Water Resources Control Board Quality Assurance Officer

Signature: ____Date: _______________

South Yuba River Citizens League

Signature: ____Date: _______________

American Rivers

Signature: ____Date: _______________

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Appendices

1. Distribution List

All staff of the South Yuba River Citizens League (SYRCL) and American Rivers working on stormwater projects, as well as consultants and technical advisors will receive copies of this Quality Assurance (QA) plan, and any approved revisions of this plan. Once approved, this QA plan will be available to any interested party by requesting a copy from Gary Reedy (see address on title page).

2. Project Organization

The *Installation of Stormwater Management in Yuba Watershed* Project is a project of American Rivers for which SYRCL will perform monitoring. The Nevada County Department of Public Works is involved as a project partner. The stormwater project will be installed by separate consultants of American Rivers.

2.1. Stormwater Monitoring Program Organization

The Stormwater Monitoring Program has identified personnel/positions whose responsibility it will be to perform the following functions.

2.1.1. Project Management

Brook Berger of SYRCL is the Stormwater Monitoring Program Coordinator. She is responsible for coordinating Stormwater Quality Monitoring, and ensuring compliance with appropriate monitoring procedures. Gary Reedy of SYRCL is the Monitoring Project Manager. He is responsible for project oversight, data review, client and regulatory correspondence and reporting. Kyle Leach is the project consultant. He is responsible for assisting SYRCL in project research and coordination, field monitoring assistance, data review and report preparation. Luke Hunt is the overall project manager for American Rivers. Luke will coordinate logistics between the monitoring team and other project partners or consultants, as well as provide final reporting to the SWRCB.

2.1.2. Equipment and Supply Management (including calibration)

All equipment will be stored at the South Yuba River Citizens League office. Brook Berger will ensure that all equipment is calibrated and that all equipment is in good working order before it is used for sampling. Staff and consultants are responsible for the proper use and cleaning of equipment after it has been used for sampling. Equipment calibration will occur before every monthly sampling day per steps outlined below in this document.

2.1.3. Field Data Collection

Brook Berger is responsible for organizing collection of field data. Kyle Leach and Gary Reedy will assist in Field data collection and data review.

2.1.4. Data Management

Brook Berger is responsible for evaluating and analyzing all data generated by the Stormwater Monitoring Program. Data will be stored as both hard copies and electronically at the South Yuba River Citizens League office at 216 Main Street, Nevada City, CA 95959.

2.1.5. Quality Assurance and Quality Control

Brook Berger will be responsible for the quality assurance program and for establishing the appropriate guidelines and for Quality Assurance and Quality Control for the chemical and physical parameters.

2.1.6. Technical Advisors

Technical advice will be solicited from experienced consultants, and regulatory agencies including the SWRCB Stormwater unit on an as needed basis. The Yuba Watershed Council Monitoring Committee TAG will also be consulted as needed.

2.2. Technical Advisors

Staff of the SWRCB Stormwater unit has been consulted in the development of this project, as have stormwater experts hired by American Rivers for project implementation The QA plan reflects the collective experience and decisions of the organizations involved in this project.

2.2.1. Technical Advisors

The technical advisors are:

- William Ray, Quality Assurance Program Manager, State Water Resources Control Board
- Eric Berntsen, Stormwater Unit, State Water Resources Control Board
- Luke Hunt, American Rivers
- Kevin Drake, Integrated Environmental Restoration Services

3. Problem Definition/Background

3.1. Problem Statement

The *Installation of Stormwater Management in Yuba Watershed* project located at the Nevada County Administrative Center (Rood Center) in Nevada City, California. Stormwater management best management practices (BMP) features including a rain garden and vegetated bioswale will be installed as a demonstration project in a highly visible public location. Post installation stormwater monitoring is an integral part of the project for the purpose of evaluating and documenting the effectiveness of the BMP features.

The South Yuba River Citizens League (SYRCL) prepared a stormwater monitoring plan to evaluate the effectiveness of the project. The plan was developed with input from staff of the Stormwater Unit at the State Water Resources Control Board (SWRCB) and may be refined through on-going dialogue and refinements based on input from the SWRCB, final construction details, and site conditions.

3.1.1.1. Project Goals

The general goals of the stormwater monitoring project are to evaluate and when feasible, quantify the benefits of the stormwater management project in 1) reducing sediment input and pollutant load and 2) reducing overall runoff by increasing stormwater runoff retention time and infiltration Stormwater Best Management Practice (BMP) features to be constructed and evaluated at the site include a rain garden, a biologically activated swale (bio swale) and several grated curb or sidewalk cuts.

3.1.1.1. Objectives of the Stormwater Monitoring Program:

The following specific objectives will be addressed by this monitoring plan.

1. Monitor reductions in the volume of stormwater runoff from site catchment areas to receiving waters through catchment and infiltration by the BMP features. Monitor the volume of stormwater runoff entering each BMP feature during storm events using a data logging rain gauge installed at the site along with calculated impervious surface catchment areas. Simulated storm events using known volumes of water applied to features will be performed to calibrate data from storm event monitoring.

2. Monitor increases in stormwater runoff retention time through observations of the timing of initial runoff into the BMP features and the timing of initial discharge from the features (if any).

3. Monitor reductions in sediment load by BMP features through observations and measurement of direct catchment, and comparisons of suspended sediment levels in inflow and outflow samples.

4. Evaluate reductions in pollutant load by BMP features through monitoring of absorption (infiltration of runoff) and assumed subsurface attenuation and reductions in discharged pollutant concentrations, as well as comparison of pollutant levels water samples entering and exiting features.

5. Establish a new SYRCL monitoring location in Oregon Ravine (receiving waters from the site) downstream of the project to include in SYRCL's on-going Yuba River basin wide monitoring program. Information from monthly water quality monitoring in Oregon Ravine will be utilized to characterize the receiving waters downstream of the project, and evaluate the need for additional projects following this pilot.

3.2. Intended Storage of Data

Stormwater Monitoring data will be compiled at 216 Main Street, Nevada City, CA, 95959. The information will be collated and shared with the State Water Resources Control Board through project reporting by American Rivers, and upon request, to other state, federal, and local agencies and organizations.

4. Project/Task Description

SYRCL will purchase and install at the site an automated tipping bucket rain gauge equipped with a data logger. Data from the rain gauge will be correlated with monitoring events and used in evaluation of the BMP feature performance. For example, low to moderate rainfall events are expected to have no outflow from the BMP features (100% runoff attenuation) and the rain gauge will enable quantification of this primary benefit. In addition the rain gauge will facilitate coordination and timing of stormwater sampling.

Three types of stormwater monitoring activities will be performed by SYRCL during the course of the project. These will include: 1) storm event monitoring, 2) simulated storm event monitoring, 3) first flush monitoring. The purpose and general scope of each type of monitoring is described below:

1. <u>Storm Event Monitoring</u> will be performed in order to monitor the capacity of the BMP features to collect and infiltrate stormwater runoff under different rainfall and soil moisture conditions and to document associated reductions in sediment and pollutant load. Storm event monitoring will be conducted after construction of the BMP features and will involve observing and documenting rainfall events and visually observing the

performance of the BMP features. Grab samples of stormwater will be collected at the inflow(s) and outfall of each BMP feature (if and when through flow or bypass occurs). Storm event monitoring samples will be tested in the field for basic water quality parameters and in the laboratory for total suspended solids (TSS) and turbidity. Selected samples may also be analyzed for pollutants and nutrients depending on the results of first flush sampling.

2. Simulated Rainfall Event Monitoring will be performed after installation of the BMP features and if possible, establishment of vegetation in the features. This test will calibrate the amount of rainfall needed to fill each feature. Data from the simulated events will be used for comparison with data from actual rainfall events and will correlate actual data with estimated catchment areas and infiltration coefficients of impermeable surfaces. A fire hose equipped with a flow meter will be used to simulate a high intensity rainfall event, washing a specific portion of the catchment areas and flood the BMP features, if possible to capacity (when through flow or bypass begins) with a measured amount of water. The test will be performed at least twice at different antecedent soil moisture conditions including one test in late summer or fall (relatively low moisture) and one during mid winter (relatively high moisture). Antecedent soil moisture conditions will be measured prior to each simulated event to allow comparison of simulated event monitoring data obtained at different soil moisture conditions. During the simulated event, grab surface water samples will be obtained from first inflowing water and first discharge (or bypass) water. Samples will be tested in the field for basic water quality parameters and in the laboratory for total suspended solids (TSS) and turbidity. Samples will be stored under refrigeration and may also be analyzed at a later date for selected pollutants and nutrients depending on the results of first flush sample analysis.

   Infiltration rates will be monitored in each BMP feature during simulated events and storm events by observing rates of decreases in standing water within features after runoff inflow has ceased.

3. First flush Monitoring will be performed during the first significant rainfall event in Fall, 2010 (after BMP feature installation). The purpose of first flush sampling will be to assess (what is assumed to be) the seasonal maximum pollutant concentrations and sediment loads in stormwater flowing into the BMP features and in the first runoff flowing from the feature discharge or bypass. If no discharge results from the initial first flush storm event, the inflow sample from this event would be analyzed for comparison with the first outflow which may be collected during a subsequent storm event. First flush grab surface water samples will be analyzed for standard water quality parameters, total suspended solids (TSS), turbidity, total dissolved solids (TDS) total oil and grease,

nutrients (nitrogen as nitrate and dissolved orthophosphate) and selected RCRA metals (mercury, chromium, copper, zinc, lead, arsenic), total coli form bacteria and e coli bacteria.

4.1. Parameters to be monitored by SYRCL

This QA plan addresses data quality objectives for the following field monitoring parameters:

- Temperature
- Dissolved Oxygen
- pH
- Conductivity
- Turbidity

In addition, on site rainfall data including storm event timing, precipitation rates and total precipitation will be monitored using a data logging rain gauge installed on site.

4.2. Parameters to be analyzed by Outside Laboratory

The sampling plan contains references and instructions for the collection of samples for the following substances.

- Total suspended solids (TSS)
- nitrogen as nitrate
- Dissolved ortho-Phosphate
- Total Coliform Bacteria
- *E. Coli* bacteria
- Copper
- Zinc
- Arsenic
- Chromium
- Lead
- Mercury
- Total Oil and Grease (TOG)

Data Quality Indicators and their associated Measurement Quality Objectives have been selected for these substances although the project proponents will contract the analysis to an outside laboratory. Cranmer Engineering and Environmental Laboratory of Grass Valley will perform the analyses. Alternatively, samples may be sent to any EPA certified laboratory capable of performing analysis.

4.3. Project Timetable

The following tables identify the specific timetables of the stormwater monitoring project included in this plan. See Tables 4-1 and 4-2 below.

Table 4-1: Monthly schedule for four types of monitoring used in this plan

Type of Monitoring	2010									2011			
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Storm Events								X	X	X			
Simulations					X					X			
First Flush								X					
Surface Water Monitoring	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 4-2 Project Schedule

Activity	Task Completion
Identify monitoring team	Completed
Obtain and check operation of instruments	On-going
Monitor Stormwater BMP feature installation	On-going
Calibration and quality control sessions	On-going
Initiate monitoring	Fall 2010
Initiate data entry	Fall 2010
Data entry	Fall Winter 2010/2011
Data review and evaluation	Fall Winter 2010/2011
Prepare Draft Report for review	Winter/Spring 2011
Final Report	Spring 2011

5. Data Quality Objectives

This section identifies how accurate, precise, complete, comparable, sensitive and representative our measurements will be. Objectives for these data characteristics are summarized in the Tables 5-1 through 5-3. Data quality objectives were derived by reviewing the QA plans and performance of citizen monitoring organizations' (e.g. Yuba Watershed Council).

Table 5-1 Data Quality Indicators and Measurement Quality Objectives for Field Measurements

Parameter	Method/range	Units	Detection Limit	Precision	Accuracy	Completeness
Temperature	Thermometer (-5 to 50)	^{o} C	-5	±1^{o}C	1^{o}C	80%
Dissolved oxygen	Electronic meter/probe	mg/L	<0.1	± 10%	± 10%	80%
pH	pH meter	pH units	2	± 0.2 units	± 0.2 units	80%
Conductivity	Conductivity meter	uS	10	5 uS or 10%, whichever is greater	10 uS or 10%, whichever is greater	80%
Turbidity	Nephelometer	NTU's	<0.1	0.2 NTU or 10%, whichever is greater	0.2 NTU or 10%, whichever is greater	80%

Table 5-2 Data Quality Indicators and Measurement Quality Objectives for Chemical Analyses

Parameters	Units	Minimum Quantization Limit	Precision	Accuracy	Recovery	Completeness
Total Suspended Solids	mg/L	5 mg/L	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by provider of material. If not available then with 80% to 120% of true value	Laboratory duplicate, Blind Field duplicate, or MS/MSD 25% RPD Laboratory duplicate minimum.	NA	80%
Copper Zinc Arsenic Chromium Lead Nickel	µg/L	Dependant on metal	Standard Reference Materials (SRM, CRM, PT) 75% to 125%.	Field replicate, laboratory duplicate, or MS/MSD ± 25% RPD. Laboratory duplicate minimum.	Matrix spike 75% - 125%.	80%
Mercury, total	ng/L	0.2 ng/L	Standard	Field	Matrix	80%

Parameters	Units	Minimum Quantization Limit	Precision	Accuracy	Recovery	Completeness
in water			Reference Materials (SRM, CRM, PT) 75% to 125%.	replicate, laboratory duplicate, or MS/MSD ± 25% RPD. Laboratory duplicate minimum.	spike 75% - 125%.	
Nitrogen as Nitrate	mg/L	0.2 mg/L	Standard Reference Materials (SRM, CRM, PT) 75% to 125%.	Field replicate, laboratory duplicate, or MS/MSD ± 25% RPD. Laboratory duplicate minimum.	Matrix spike 75% - 125%.	80%
Dissolved Orthophosphate	mg/L	0.01 mg/L	Standard Reference Materials (SRM, CRM, PT) 75% to 125%.	Field replicate, laboratory duplicate, or MS/MSD ± 25% RPD. Laboratory duplicate minimum.	Matrix spike 75% - 125%.	80%
Total Coli form Bacteria	MPN/100 mL	2.0 /100 mL	Standard Reference Materials (SRM, CRM, PT) 75% to 125%.	Field replicate, laboratory duplicate, or MS/MSD ± 25% RPD. Laboratory duplicate minimum.	Matrix spike 75% - 125%.	80%
e-coli bacteria	MPN/100 mL	2.0 /100 mL	Standard Reference Materials (SRM, CRM, PT) 75% to 125%.	Field replicate, laboratory duplicate, or MS/MSD ± 25% RPD. Laboratory duplicate minimum.	Matrix spike 75% - 125%.	80%
Total Oil and Grease (TOG)	µg/L	50 µg/L	Standard Reference Materials (SRM, CRM, PT) within 95% CI stated by	Laboratory duplicate, Blind Field duplicate, or MS/MSD 25% RPD Laboratory	Matrix spike 80% - 120% or control limits at ± 3 standard deviations	80%

Parameters	Units	Minimum Quantization Limit	Precision	Accuracy	Recovery	Completeness
			provider of material. If not available then with 80% to 120% of true value	duplicate minimum.	based on actual lab data.	

5.1. Accuracy

Description: Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value. Performing tests on standards at periodic quality control sessions held by the Yuba Watershed Council twice a year will check the accuracy of field measurements. A standard is a known concentration of a certain solution. Standards can be purchased from chemical or scientific supply companies. A professional partner, e.g. a local analytical laboratory, certified for water or wastewater analysis by EPA might also prepare standards. Single or double blind samples may be submitted at the discretion of the Quality Assurance Officer.

Procedures: For all chemical water quality parameters, stormwater monitoring staff shall obtain results within the stated data quality objectives in Tables 5.1 – 5.3. Testing will be done through the analysis of a solution of known concentration, which will be within 25% to 75% of the range of measurable values.

Accuracy for bacterial parameters will be determined by analyzing a positive control sample. A positive control is similar to a standard, except that a specific discreet value is not assigned to the bacterial concentrations in the sample. This is due to the fact that bacteria are alive and capable of mortality and reproduction. Instead of a specific value, an approximate target value of the bacterial concentration is assigned to the sample by the laboratory preparing the positive control sample.

Instructions for determining accuracy (chemical analyses):
Record all results from the test for each instrument. Determine the average value. Compare the average value to the true value. Compare this difference to the accuracy objective set in the previous tables. If the absolute difference is greater, corrective action will be taken to improve performance. We will consult the project manager or technical advisors to determine the appropriate corrective action.

Table 5-3 Example of QA Form: Data accuracy

Parameter/ units	Date	Objective	Deviation	Meet Objective? Yes or No	Corrective action planned	Date Corrective Action taken
Temperature ^{O}C	5/21/ 96	±1°C	1.5 °C -0.5%* * after correction factor given.	Yes	One thermometer was way off, it was discarded. All other thermometers were given a correction factor to improve their accuracy	5/21/96
Dissolved Oxygen (mg/L)	5/21/ 96	sodium thiosulfate 20.00± 0.2mL	+1.00 mL	No	replace reagent	6/15/96
PH Standard units	5/21/ 96	±10%	-5%	yes	none needed	
Conductivity (µS/cm)	5/21/ 96	±10%	+10%	yes	none needed	
Turbidity (NTU)	5/21/ 96	± 5	+1.4	yes	none needed	

5.2. Standardization of Instruments and Test Procedures (chemical and physical parameters)

The temperature measurements will be standardized by comparing our thermometers to a NIST-certified or calibrated thermometer. All meters (pH, conductivity, oxygen) will be evaluated twice a year using standards of known value. The data logging rain gauge will be installed and calibrated per manufacturers recommendations.

5.3. Comparability

Description: Comparability is the degree to which data can be compared directly to similar studies. Procedures: In order to make sure data from this project is comparable to other projects, we will follow two methods to ensure that data is comparable:

- SWRCB Stormwater Ambient Monitoring Program (SWAMP) protocol
- U.S. EPA Urban Stormwater BMP Performance Monitoring Manual

Before modifying any measurement method, or developing alternative or additional methods, the project manager or technical advisors will evaluate and review the effects of the potential modification. It will be important to address their concerns about data quality before proceeding with the monitoring program.

5.4. Completeness

Description: Completeness is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project. There are no statistical criteria that require a certain percentage of data. However, it is expected that 80% of all measurements could be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

Procedures: We will determine completeness by comparing the number of measurements we planned to collect compared to the number of measurements we actually collected that were also deemed valid. An invalid measurement would be one that does not meet the sampling methods requirements and the data quality objectives. Completeness results will be checked at the completion of the field monitoring phase of the project. Completeness measurements shall meet the requirements stated in Tables 5.1 – 5.3. Table A3 (Appendix 3) will be used to record our completeness information.

Instructions for Determining Completeness:

To determine the percent completed divide the number of valid samples collected and analyzed by the number of samples anticipated in the monitoring design then multiply by 100%.

5.5. Precision

Description: Precision describes how well repeated measurements agree. The precision objectives described here refer to repeated measurements taken on the same water sample. Additional variability would be expected if comparisons were made between different samples taken at the same location.

Procedures: These precision objectives apply to duplicate and split samples taken during and field water quality parameter monitoring. For chemical and physical parameters measurements on the same sample using the same equipment shall meet the data quality objectives stated in Tables 5.1 – 5.3.

Instructions for Determining Precision (chemical analyses):
Staff runs repeated tests on the same sample. Record all results from the test for each instrument. Determine the average value. Calculate the standard deviation and determine the

percent precision. Compare the percent precision result to the precision objective set in Tables 5.1 – 5.3. If the precision is outside of the objectives, corrective action will be taken to improve performance. If necessary we will consult with technical advisors to determine the appropriate corrective action.

5.6. Representativeness

Description: Representativeness describes how relevant the data are to the actual environmental condition.

Problems can occur if:

- Samples are not taken in the same location during each monitoring event.
- Samples are not taken within the same time range relative to the initiation of the precipitation/ runoff event.
- Samples are not analyzed or processed appropriately, causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

Representativeness will be ensured by processing the samples in accordance with Section 8, 9 and 10, by following the established methods, and by obtaining approval of this document.

Procedures: the project coordinator will conduct a review of sampling procedures and audits of sampling events. Any deviations noted are to be reported to the Project Manager.

6. Training Requirements and Certification

The monitoring coordinator and monitoring personnel shall have a minimum of a Bachelors Degree in Water Resources, Biology or Earth Sciences and have applicable experience and training in measurement of water quality, flow, water sampling techniques, quality assurance and representativeness. The monitoring coordinator has participated in water quality monitoring training conducted by the State Water Quality Control Board. The following topics are covered under this training:.

- ♦ Safety
- ♦ Quality Assurance and Quality Control Measures
- ♦ Sampling Procedures
- ♦ Field Analytical Techniques
- ♦ Data recording.

The monitoring coordinator will examine field kits for completeness of components: date, condition, and whether the equipment is in good repair. The project coordinator will check data quality by testing equipment against blind standards. The project coordinator will also ensure that instruments are read and results recorded correctly. Sampling and safety techniques will also be evaluated. The project coordinator will discuss corrective action with the project manager, and the date by which the action will be taken. The project coordinator is responsible for reporting back that the corrective action has been taken. Certificates of completion will be provided once all corrective action has been completed.

7. Documentation and Records

All field results will be recorded at the time of completion, using the field data forms (see Appendix 2). Data forms will be reviewed for outliers and omissions before leaving the sample site. Data forms will be stored in hard copy form at the SYRCL Office. Field data forms will be archived for three years from the time they are collected. These data forms can be found in Appendix 2.

If data entry is performed at another location, duplicate data forms will be used, with the originals remaining at the headquarters site. Data will be stored electronically every month. Hard copies of all data, as well as computer back-up, are maintained at SYRCL office located at 216 Main St, Nevada City, CA, 95959.

The monitoring coordinator will also keep a maintenance log. This log details the dates of equipment inspection and calibrations, as well as the dates reagents are replaced.

Data will be protected using an electronic back-up system along with a battery surge protection, which will automatically back-up incoming data for any power loss and shut down the system.

8. Sampling Process Design

8.1. Rationale for Selection of Sampling Locations

The stormwater monitoring plan for the project calls for collection of one influent sample from each of the two BMP features during each monitoring event. One effluent sample will also be collected from each feature if and when BMP feature capacity has been reached and through flow occurs. A total of four sample locations will be used during the project.

8.2. Sample Design Logistics

At the time this QAPP was prepared, the BMP feature construction had not been completed. However, based on review of feature design and discussions with the construction contractors, we assume curb cuts will be constructed to direct stormwater runoff in and out of each feature. We assume one influent location and one effluent location for a total of four sampling locations for the project.

Curb cuts will be constructed to direct runoff relatively evenly over an approximately two to three foot wide spillway. A notch will be added at each spillway with a 4 to 6 inch drop into the feature to facilitate sample collection. Sample locations will be indicated on as-built drawings once BMP feature construction is completed.

9. Sampling Method Requirements

Samples will be taken by placing the appropriate sample container under the spillway constructed in the BMP feature curb cut influent of effluent location. Van Dorn, LaMotte or plastic or glass sampling bottles supplied by the analytical laboratory will be used for all samples submitted to the laboratory.

Sampling devices will be rinsed three times with sample water prior to taking each sample except for prepared bottles provided by laboratory.

The following table describes the sampling equipment, sample holding container, sample preservation method and maximum holding time for each parameter.

Table 9-1 Sampling Method Requirements

Parameter	Sampling Equipment	Preferred / Maximum Holding Times
Conventional Parameters		
Temperature	Digital, plastic or glass container or sample directly	Within 15 minutes
Dissolved Oxygen	glass D.O. bottle Not relevant if using DO meter	Within 15 minutes / continue analysis within 8 hr. Sampler will wear gloves.
PH	Plastic or glass container Directly?	Within 15 minutes
Conductivity	Plastic or glass container Directly?	Within 15 minutes/ refrigerate up to 28 days
Turbidity	plastic or glass container	Within 15 minutes/ store in dark for up to 24 hr.
Laboratory Analysis of Chemical Parameters		
Nutrients		
Nitrates	Van Dorn, LaMotte or plastic sampling bottle	Within 15 minutes / refrigerate in dark for up to 48 hr.
Orthophosphate	Van Dorn, LaMotte or plastic sampling bottle	Within 15 minutes or refrigerate immediately and analyze within 48 hours
Sediment		

Parameter	Sampling Equipment	Preferred / Maximum Holding Times
Total Suspended Solids	Van Dorn, LaMotte or plastic sampling bottle	Within 7 days
Total Dissolved Solids	Van Dorn, LaMotte or plastic sampling bottle	Within 7 days
Metals		
Metals except mercury	Acid and DI water rinsed plastic sampling bottle	Send to lab immediately; fix with Ultrapure (or comparable) nitric acid. Sampler will wear gloves.
Mercury	Proper sample bottle of borosilicate glass or polyfluorocarbon obtained from laboratory performing analysis. Group will not prepare bottles	Laboratory will provide preservative of hydrochloric acid as prescribed in EPA method 1630e, section 8
Hydrocarbons		
Total Oil and Grease	Solvent rinsed and dried rinsed glass sampling bottle, Teflon liner in lid	Send to lab immediately Preserve at lab with HCl 28 Days hold time
Biological Samples		
Total Bacteria	sterile plastic sampling bottle or whirl-pack	Refrigerate to 4 degrees C in the dark; delivered to the lab within 4 hours, start analysis within 6 hours, unless precluded by distant transportation issues in which case no later than 24 hours from sampling; sampler will wear gloves.
E coli Bacteria	sterile plastic sampling bottle or whirl-pack	Refrigerate to 4 degrees C in the dark; delivered to the lab within 4 hours, start analysis within 6 hours, unless precluded by distant transportation issues in which case no later than 24 hours from sampling; sampler will wear gloves.
Nutrients		
Nitrogen as Nitrate	sterile plastic sampling bottle or whirl-pack	Refrigerate to 4 degrees C in the dark 48 hours
Dissolved Orthophosphate	sterile plastic sampling bottle or whirl-pack	Refrigerate to 4 degrees C in the dark 48 hours

10. Sample Handling and Custody Procedures

10.1. Sample Handling

Identification information for each sample will be recorded on the field data forms (see Appendix 2) when the sample is collected. Samples are normally processed in the field. Samples will be labeled with the BMP feature name, sample location (influent or effluent), sample number, data and time of collection, sampler's name, and method used to preserve sample (if any).

10.2. Custody Procedures

The conventional water quality parameter monitoring tests do not require specific custody procedures since they will, in most cases, be conducted immediately by the same person who performs the sampling. In certain circumstances (such as driving rain or extreme cold), samples will be taken to a nearby residence or office for analysis.

When analytical samples are transferred from the sampler to an outside professional laboratory, then a Chain of Custody form should be used. This form identifies the BMP feature name, sample location, sample number, data and time of collection, sampler's name, and method used to preserve sample (if any). It also indicates the date and time of transfer, and the name and signature of the sampler and the sample recipient. It is recommended that the Chain of Custody form used be the one provided by the outside professional laboratory. When a professional lab performs quality control checks, their samples will be processed under their chain of custody procedures with their labels and documentation procedures.

11. Analytical Methods Requirements

Only US EPA certified analytical laboratories will be sued for sample analysis. Water chemistry is monitored using protocols determined during laboratory certification and quality assurance/quality control (QA/QC) procedures at the laboratory.

Table 11.1 outlines the methods to be used, any modifications to those methods, and the appropriate reference to a standard method.

Table 11.1 Analytical Methods for Water Quality Parameters

Parameter	Method	Modification	Reference (a)
Temperature	Thermometric	Alcohol-filled thermometer marked in 0.5^{o}C increments Or digital therm	2550 B.
Dissolved Oxygen	Membrane Electrode	none	4500-O G.
pH	Electrometric	none	4500-H B.
Turbidity	Nephelometric	none	2130 B
Nitrate	EPA 300.0 Ionic Chromatography	None, Refrigerate	4500 – NO_3^- E.

Parameter	Method	Modification	Reference (a)
Ortho-Phosphate	Ascorbic acid	Prepackaged reagents, colorimeter or spectrophotometer	4500 – P E.
Total Suspended Solids	Filter, Dehydrate, Weigh	none	2540 D
Total Dissolved Solids	Filter, Dehydrate, Weigh	none	2540 D
Metals except mercury	Inductively coupled plasma	none	3120B or EPA method 200.8
Mercury	Atomic absorbance	none	EPA method 1631 for aqueous samples, EPA method 7473 (SW-846) for solid samples & small aqueous samples
Total oil and grease	Hexane extraction	HCl	EPA method 1664
Total Bacteria	Colilert 18 hour	none	Idexx
E. Coli Bacteria	Colilert 18 hour	none	9223 B

All of the above cited methods, except where noted are described in Standard Methods for the Examination of Water and Wastewater:
Andrew D. Eaton, Lenore S. Clesceri, Arnold E. Greenberg, Mary Ann H. Franson.
Standard Methods for the Examination of Water and Wastewater, prepared and published jointly By American Public Health Association, American Water Works Association, Water Environment Federation, 20th edition, Washington, DC: American Public Health Association, 1998.

12. Quality Control Requirements

Quality control samples may be taken to ensure valid data are collected. Depending on the parameter, quality control samples may consist of field blanks, replicate samples, or split samples.

Quality control samples will be collected for field water quality parameter monitoring. Based on the limited scope and budget of the project, quality control samples may not be collected for samples requiring laboratory analysis. Approximately 20 to 30 samples requiring laboratory analysis are proposed during the course of the project. If suspect results are reported or if the project involves additional sampling, quality control samples may be collected.

In addition, SYRCL participates in quality control sessions (a.k.a. intercalibration exercises) held twice a year to verify the proper working order of equipment, refresh samplers in monitoring techniques and determine whether the data quality objectives are being met.

12.1. Field/Lab Blanks, Duplicate Field Samples, and Split Samples

Table 12.1 describes the quality control regimen.

Field/Laboratory Blanks: For turbidity and if applicable, specific chemical analysis (see Table 12-1) performed in the field blanks (a.k.a. reagent blanks) will be taken once every 20 samples.

Instructions for Field and Lab Blanks (if required): Distilled water is taken into the field or used in the laboratory and handled just like a sample. It will be poured into the sample container and then analyzed. Field blanks are recorded on the normal sampling datasheet.

Duplicate Field Samples: For field water quality parameter monitoring samples, duplicate field samples will be taken once every 20 samples. Duplicate samples will be collected as soon as possible after the initial sample has been collected, and will be subjected to identical handling and analysis.

Table 12-1 Quality Control Requirements for Water Quality Parameters

Parameter	Blank	Duplicate Sample	Split Sample to lab	QC session
Water quality				
Temperature	None	5% or a minimum of once a year	none	twice a year
Dissolved Oxygen	None	5% or a minimum of once a year	none	twice a year
pH	None	5% or a minimum of once a year	none	twice a year
Conductivity	5%	5% or a minimum of once a year	twice a year	twice a year
Turbidity	5%	5% or a minimum of once a year	twice a year	twice a year

13. Instrument/Equipment Testing, Inspection and Maintenance Requirements

The monitoring coordinator keeps a maintenance log. This log records reagent use and any problems noted with equipment. Calibration information is recorded on the datasheets.

13.1. Temperature

Before each use, thermometers are checked for breaks in the column. If a break is observed, the alcohol thermometer will be placed in nearly boiling water so that the alcohol expands into the expansion chamber and the alcohol forms a continuous column. Verify accuracy by comparing with a calibrated or certified thermometer.

13.2. pH and Conductivity and Dissolved Oxygen

Before each use, pH conductivity and dissolved oxygen meters are checked to see if they are clean and in good working order. pH and conductivity meters are calibrated before each use. pH buffers and conductivity standards are replaced at least annually or prior to expiration date, whichever is sooner. Conductivity and pH standards are stored with the cap firmly in place and in a dry place kept away from extreme heat and light. Do not re-use pH or conductivity standards. pH meters are stored upright to maintain electrode connection to moisture. pH meters are rinsed after use in a pH 4 solution and stored in pH 4 solution.

13.3. Turbidity

Before each use, turbidity tubes are checked to ensure that they are clean. The turbidity standard will be replaced prior to expiration date. Sample cuvette is rinsed three times with DI water after use.

14. Instrument Calibration and Frequency

Instruments will be calibrated accordingly to the following schedule. Standards will be purchased from a chemical supply company or prepared by a laboratory certified by U.S. EPA for chemical analysis of water or wastewater. Calibration records will be kept at a location where they can be easily accessed before and after equipment use. This will likely be at the SYRCL main office or the monitor's home.

Records for the calibration of instruments used by contract laboratories are referenced in their laboratory quality manual, which can be viewed upon request.

Table 14-1 Instrument Calibration and Frequency Conventional Water Quality Parameters

Equipment Type	Calibration Frequency	Standard or Calibration Instrument Used
Temperature	Every 6 months	NIST calibrated or certified thermometer
Dissolved Oxygen Meter	Every sampling day	At a minimum, water saturated air, according to manufacturer's instructions.
pH	Every sampling day	pH 7.0 buffer and pH 4.0 buffer
Conductivity	Every sampling day	conductivity standard
Turbidity meter (nephelometer)	Every sampling day	For clear ambient conditions use an 1.0 NTU standard, for turbid conditions use an 10.0 NTU standard

15. Inspection/Acceptance Requirements

Upon receipt, or prior to initiation of the monitoring program, all other sampling equipment will be inspected for broken or missing parts, and will be tested to ensure proper operation.

Before usage, thermometers are inspected for breaks. Breaks can be eliminated by heating. If not, they will be returned to the manufacturer.

16. Data Acquisition Requirements

16.1. Analytical Data

Only US EPA certified analytical laboratories (likely Cranmer Engineering and Analytical Laboratory of Grass Valley, California) will be used for quality assurance checks. The project manager or project consultant will review these laboratories' data. They will review the lab's own quality control data to ensure data validity.

16.2. Geographical Information/ Mapping

Upon completion of the BMP feature installation at the site, we anticipate that the project engineer will prepare as built drawings showing specific site features including catchment areas, BMP feature details, curb cut/ stormwater monitoring influent and effluent sample locations, and storm drain drop inlets. These drawings and maps will be included in the final monitoring report for the project and referred to during monitoring data evaluation.

17. Data Management

Field data sheets are checked and signed in the field by the monitoring coordinator or consultant who collects the data. The monitoring coordinator will flag as unusable any results where holding times have been exceeded, sample identification information is incorrect, samples were inappropriately handled, or calibration information is missing or inadequate.

Independent laboratories will report their results to the monitoring leader. The leader will verify sample identification information, review the Chain-of-Custody forms, and identify the data appropriately in the database. These data are also reviewed by the project manager and or project consultant.

The data management coordinator will review the field sheets and enter the data deemed acceptable by the project manager. Data will be entered into an MS Excel or Access format spreadsheet or a database using a format that is compatible with the State Water Resources Control Board or Regional Water Quality Control Board's database guidelines. The data coordinator will review electronic data, compare to the original data sheets and correct entry errors. After performing data checks, and ensuring that data quality objectives have been met, data analysis will be performed.

Raw data, once approved by the project manager will be provided to the SWRCB in electronic form upon request. Appropriate quality assurance information can also be provided upon request.

18. Assessment and Response Actions

Review of all field and data activities is the responsibility of the monitoring coordinator with the assistance of the project manager and consultant.

19. Reports

The project manager and consultant will review raw data to be included in reports to ensure accuracy, precision and proper data analysis. Upon completion of the monitoring phase of the project, approved data will be analyzed to evaluate the effectiveness of the BMP features. A final monitoring report will be prepared which will summarize field monitoring activities, evaluate data and provide conclusions regarding the effectiveness of the BMP features installed at the site. The report will include copies of field data sheets and other monitoring data, document analytical procedures, and include copies of all analytical laboratory reports and chain of custody documentation.

20. Data Review, Validation and Verification

Data forms or data files are reviewed after every monitoring event to determine if the data meets the Quality Assurance Project Plan objectives. They will identify outliers, spurious results or omissions to the monitoring coordinator. They will also evaluate compliance with the data quality objectives. They will suggest corrective action that will be implemented by the monitoring coordinator. Problems with data quality and corrective action will be reported in final reports.

21. Validation and Verification Methods

As part of standard field protocols, any sample readings out of the expected range will be reported to the project manager. A second sample will be taken if possible to verify the condition. It is the responsibility of the monitoring coordinator to resample or reevaluate equipment until performance is acceptable.

22. Reconciliation with DQOs

The Project Manager will review data periodically to determine if the data quality objectives (DQOs) have been met. If not, he will suggest corrective action. If data do not meet the project's specifications, the following actions will be taken. First, the project manager and or project consultant or technical advisors will review the errors and determine if the problem is equipment failure, calibration/maintenance techniques, or monitoring/sampling techniques. If the problem cannot be corrected by training, revision of techniques, or replacement of supplies/equipment, then the project manager, consultant or technical advisors will review the DQOs and determine if the DQOs are feasible. If the specific DQOs are not achievable, they will determine whether the specific DQO can be relaxed, or if the parameter should be eliminated from the monitoring program. Any revisions to DQOs will be appended to this QA plan with the revision date and the reason for modification.

Appendix 1 Stormwater Monitoring Plan

Draft Monitoring Plan for Stormwater Demonstration Project at the Nevada County Rood Center
Prepared for American Rivers
by Kyle Leach and Gary Reedy[1]

The South Yuba River Citizens League (SYRCL) has prepared this stormwater monitoring plan to evaluate the effectiveness of the *Installation of Stormwater Management in Yuba Watershed* project located at the Nevada County Administrative Center (Rood Center) in Nevada City, California. This plan has been developed with input from staff of the Stormwater Unit at the State Water Resources Control Board (SWRCB) and may be refined through on-going dialogue and refinements based on input from the SWRCB, final construction details, and site conditions.

SYRCL's scope for the project includes preparation of this stormwater monitoring plan, coordination with regulatory agencies and project partners, performing water quality monitoring during selected storm events and simulated storm events, analysis of monitoring data and preparation of a monitoring project report documenting the benefits of the project as assessed through this plan.

Purpose

The purpose of stormwater monitoring for the project is to evaluate and when feasible, quantify the benefits of the stormwater management project in 1) reducing sediment input and pollutant load and 2) reducing overall runoff by increasing stormwater runoff retention time and infiltration Stormwater Best Management Practice (BMP) features to be constructed and evaluated at the site include a rain garden, a biologically activated swale (bio swale) and several grated curb or sidewalk cuts. Grated curb cuts will direct stormwater into and out of the rain garden and bio swale and thus will be monitored in conjunction with these two main BMP features.

The following specific objectives will be addressed by this monitoring plan.

6. Monitor reductions in the volume of stormwater runoff from site catchment areas to receiving waters through catchment and infiltration by the BMP features. Monitor the volume of stormwater runoff entering each BMP feature during storm events using a data logging rain gauge installed at the site along with calculated impervious surface catchment areas. Simulated storm events using known volumes of water applied to features will be performed to calibrate data from storm event monitoring.

7. Monitor increases in stormwater runoff retention time through observations of the timing of initial runoff into the BMP features and the timing of initial discharge from the features (if any).

8. Monitor reductions in sediment load by BMP features through observations and measurement of direct catchment and comparisons of suspended sediment levels in inflow and outflow samples.

9. Evaluate reductions in pollutant load by BMP features through monitoring of absorption (infiltration of runoff) and assumed subsurface attenuation and reductions in discharged

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pollutant concentrations, as well as comparison of pollutant levels water samples entering and exiting features.

10. Establish a new SYRCL monitoring location in Oregon Ravine (receiving waters from the site) downstream of the project to include in SYRCL's on-going Yuba River basin wide monitoring program. Information from monthly water quality monitoring in Oregon Ravine will be utilized to characterize the receiving waters downstream of the project, and evaluate the need for additional projects following this pilot.

    The lower Oregon Ravine monitoring site will support a general watershed scale evaluation of the project receiving waters. However, watershed data collected during this project will not be sufficient to quantify the effects of the BMP project on the receiving waters due to the relatively small catchment area of the BMP features, lack of pre-treatment data and inability to isolate sources and magnitudes of pollutants within the catchment area

Current Site Conditions

The proposed rain garden, located in the center of the site to the south of the Nevada County Government Center building, currently consists of a landscaped area bounded by curbs. The rain garden area currently does not receive normal stormwater runoff from other areas of the site. Storm drain drop inlets are located up slope of the proposed rain garden and near the proposed rain garden outfall location which direct stormwater into a culvert which discharges along the north side of Highway 49 in the south central portion of the site. This culvert discharge also includes runoff from other areas of the site as well as off-site catchment areas to the north and northeast of the site. The culvert discharges to Oregon Ravine which flows through downtown Nevada City to Deer Creek, a tributary of the Yuba River.

The proposed bio swale, located in the west central portion of the site in an are surrounded by parking lot between the Rood Government Center building and the Wayne Brown Correctional facility building also currently consists of a landscaped area bounded by curbs. The bio swale currently does not receive normal stormwater runoff from other areas of the site. Storm drain drop inlets are located up slope of the proposed bio swale and near low points along the center of the north side and near the west end of the swale. These drop inlets direct stormwater into a culvert which may flow to Oregon Ravine (at the same discharge as rain garden) or could flow to a second culvert which discharges near the southwest corner of the site and flows to another small tributary to Deer Creek.

Monitoring Activities

SYRCL will purchase and install at the site an automated tipping bucket rain gauge equipped with a data logger. Data from the rain gauge will be correlated with monitoring events and used in evaluation of the BMP feature performance. For example, low to moderate rainfall events are expected to have no outflow from the BMP features (100% runoff attenuation) and the rain gauge will enable quantification of this primary benefit. In addition the rain gauge will facilitate coordination and timing of stormwater sampling.

Three types of stormwater monitoring activities will be performed by SYRCL during the course of the project. These will include: 1) storm event monitoring, 2) simulated storm event monitoring, 3) first flush monitoring. The purpose and general scope of each type of monitoring is described below:

4. Storm Event Monitoring will be performed in order to monitor the capacity of the BMP features to collect and infiltrate stormwater runoff under different rainfall and soil moisture conditions and to document associated reductions in sediment and pollutant load. Storm event monitoring will be conducted after construction of the BMP features and will involve observing and documenting rainfall events and visually observing the performance of the BMP features. Grab samples of stormwater will be collected at the inflow(s) and outfall of each BMP feature (if and when through flow or bypass occurs). Storm event monitoring samples will be tested in the field for basic water quality parameters and in the laboratory for total suspended solids (TSS) and turbidity. Selected samples may also be analyzed for pollutants and nutrients depending on the results of first flush sampling.

5. Simulated Rainfall Event Monitoring will be performed after installation of the BMP features and if possible, establishment of vegetation in the features. This test will calibrate the amount of rainfall needed to fill each feature. Data from the simulated events will be used for comparison with data from actual rainfall events and will correlate actual data with estimated catchment areas and infiltration coefficients of impermeable (?) surfaces. A fire hose equipped with a flow meter will be used to simulate a high intensity rainfall event, washing a specific portion of the catchment areas and flood the BMP features, if possible to capacity (when through flow or bypass begins) with a measured amount of water. The test will be performed at least twice at different antecedent soil moisture conditions including one test in late summer or fall (relatively low moisture) and one during mid winter (relatively high moisture). Antecedent soil moisture conditions will be measured prior to each simulated event to allow comparison of simulated event monitoring data obtained at different soil moisture conditions. During the simulated event, grab surface water samples will be obtained from first inflowing water and first discharge (or bypass) water. Samples will be tested in the field for basic water quality parameters and in the laboratory for total suspended solids (TSS) and turbidity. Samples will be stored under refrigeration and may also be analyzed at a later date for selected pollutants and nutrients depending on the results of first flush sample analysis.

   Infiltration rates will be monitored in each BMP feature during simulated events and storm events by observing rates of decreases in standing water within features after runoff inflow has ceased.

6. First flush Monitoring will be performed during the first significant rainfall event in fall, 2010 (after BMP feature installation). The purpose of first flush sampling will be to assess (what is assumed to be) the seasonal maximum pollutant concentrations and sediment loads in stormwater flowing into the BMP features and in the first runoff flowing from the feature discharge or bypass. If no discharge results from the initial first flush storm event, the inflow sample from this event would be analyzed for comparison with the first outflow which may be

collected during a subsequent storm event. First flush grab surface water samples will be analyzed for standard water quality parameters, TDS, turbidity, total dissolved solids (TDS) Total Oil and Grease, nutrients (nitrogen as nitrate and dissolved orthophosphate) and RCRA metals (mercury, copper, zinc, lead, arsenic), total coli form and E. coli.

Timing and Proposed Number of Monitoring Events

With the exception of watershed monitoring and construction monitoring, monitoring activities will occur following construction of BMP features (Table 1). Due to the timing of the start of the monitoring project (winter 2010 after the 2009 first flush) and since no treatment is occurring prior to BMP feature construction, pre-construction monitoring would not provide meaningful data to support monitoring objectives. SYRCL has and will continue to make visual observations of stormwater runoff conditions at the proposed BMP feature locations and catchment areas during the winter and spring of 2010.

Construction Monitoring

Installation of the BMP features is scheduled for the summer of 2010. Since there is typically little or no rainfall during the summer months, we do not anticipate stormwater monitoring will be performed during the construction phase of the project. If an unusual storm event occurs, we anticipate any disturbed soil exposed would be covered to limit runoff. SYRCL staff will periodically observe construction of the BMP features and coordinate with other project partners to facilitate an understanding of expected feature performance. The data logging rain gauge will be installed at the site and tested during the construction phase of the project to facilitate monitoring of first flush and subsequent storm events.

Table 1: Monthly schedule for four types of monitoring used in this plan

Type of Monitoring	2010									2011			
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Storm Events								X	X	X			
Simulations					X					X			
First Flush								X					

Post-construction Monitoring

Two simulated rainfall monitoring events will be conducted on BMP features after installation, each at different antecedent moisture conditions. The first event will be conducted during relatively low soil moisture conditions in the late summer or early fall within one to two months of construction. Assuming construction is completed by June 2010, this will allow vegetation to be established and soil moisture conditions to equilibrate. The first simulated event will be performed before the onset of the rainy season. The second simulated rainfall monitoring event will be performed during a period of relatively high soil moisture conditions in mid winter (January or February 2011). The timing of the event will be selected to coincide with a dry period within a few days after a significant rainfall event and after all stormwater runoff from that event has been infiltrated with underlying soil at or near saturated conditions.

Preliminary hydrological calculations suggest the rain garden as designed will have a relatively high saturation capacity both in volume (approximately 3,448 cubic feet or 25,860 gallons) and in relation to the catchment area. Thus, the rain garden is expected to absorb and infiltrate 100% of inflow runoff from all but the largest storm events. In contrast, the bio swale is expected to have a saturated capacity of approximately 736 cubic feet (5,520 gallons) and is likely to discharge runoff from more rain events. If post construction details confirm this relationship and a sufficient low cost water source is unavailable, the simulated rainfall events will only be performed on the bio swale and calibrated performance results would be extrapolated to the rain garden.

One first flush monitoring event will be performed during the first significant rainfall event of fall 2010 after the BMP features have been constructed and feature vegetation has been established. Based on a review of historic rainfall data, we anticipate the first significant storm event (greater than 1-inch in 24 hour predicted rainfall) will occur between mid October and early November 2010.

A minimum of six to eight stormwater event monitoring events will be performed during the fall of 2010 and winter and spring of 2011 after construction of the BMP features. Monitoring will be conducted during storm events of various magnitudes, particularly larger storm events likely to exceed the design maximum treatment volume for the bio swale and, if events are large enough, the rain garden.

Monitoring events will be selected based on predicted rainfall amounts and duration. During the events, stormwater will be sampled as it enters each BMP feature (inflowing water). Stormwater will also be sampled at the BMP feature outfall if and when this occurs. Rainfall rates, rain duration and total rainfall will be recorded with the on-site tipping bucket rain gauge. SYRCL will also visually observe and document the performance of the grated curb cuts and sidewalk cut features during storm runoff events.

Water Quality Parameter Monitoring and Laboratory Sample Analysis

The following water quality parameters will be monitored during each stormwater event monitoring event using field instruments: Temperature, pH, Conductivity and Dissolved Oxygen. Turbidity analysis will be performed in SYRCL's office. Stormwater samples will be sent to Cranmer Analytical Laboratory for testing of total suspended solids (TSS). Based on recent conversations with SWRCB staff, suspended solid concentration (SSC) analysis may be used instead of TSS if feasible.

First flush samples will be monitored for field parameters, turbidity and TSS. Additional laboratory analyses will include total dissolved solids (TDS), Total oil and grease (TOG), RCRA Metals (mercury, copper, chromium, lead, nickel and zinc), selected nutrients (nitrate as nitrogen and dissolved orthophosphates), e-coli and total coli form. A Quality Assurance Program Plan (QAPP) will be submitted to the SWRCB following SWAMP guidance protocols and this plan will include specific laboratory methods and laboratory reporting limits for these analytes.
First flush BMP feature inflow samples will be analyzed for all the constituents listed above. Outflow samples will be held under refrigeration and later analyzed for selected constituents based on a review of inflow sample results. For example, outflow samples may not be analyzed for constituents not detected in inflow samples or detected at relatively low concentrations based on a literature review of typical stormwater runoff characterization data.

Samples obtained during the simulated rainfall event monitoring from inflow and outflow will be monitored for field parameters, turbidity and TSS. Samples will also be held under refrigeration at SYRCL offices or the laboratory and later analyzed for selected constituents based on a review of first flush sample results.

Data Evaluation and Reporting

Upon completion of the monitoring period, data from the three monitoring activities will be evaluated to assess project performance. Calculations will be performed and a project evaluation report will be prepared to address each of the four established monitoring objectives.

1. Volume of stormwater runoff entering each BMP feature will be calculated for specific stormwater monitoring events and calculations of runoff coefficients for catchment areas will be performed based on data recorded from the on-site rain gauge, BMP feature construction details, hydrological calculations and data collected during specific storm event and simulated rainfall event monitoring. Reductions in volume of stormwater runoff entering receiving waters will be calculated for specific events and seasonal estimates will be made based on specific storm event monitoring and simulated rainfall event monitoring data.

2. Stormwater runoff retention time within BMP features will be calculated based on field observations of initial inflow and outflow times during stormwater monitoring events which represent the delayed timing of inflow to receiving waters. Infiltration rates will be calculated based on observations of water level reduction rates within the BMP features after inflow has ceased during the simulated rainfall monitoring events and during the later part of stormwater monitoring events.

3. Reductions in sediment load entering receiving waters through deposition within the BMP features will be calculated based on turbidity and TSS analysis of inflow samples which are completely infiltrated and when discharge occurs, through comparison of inflow and outflow turbidity and sediment concentrations.

4. Reductions in pollutant load entering receiving waters through infiltration and treatment within the BMP features and underlying soil will be calculated based on sample analysis of pollutant concentrations in inflow samples which represent 100% infiltrated runoff and, when discharge occurs, through comparison of inflow and outflow pollutant concentrations.

Appendix 2 Field Data Form

Appendix 3 Data Quality Forms

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Data Quality Form: Accuracy **Quality Control Session**

Monitoring Site	Type of Session (field or lab)
Your Name	Quality Assurance Leader
Date	

Parameter/ units	Sensitivity	Accuracy Objective	Standard Conc.	Analytical Result	Estimated Bias	Meet Objective? Yes or No	Corrective action planned	Date Corrective Action taken
Temp. ^{o} C								
Dissolved Oxygen (mg/L)								
pH standard units								
Conductivity (uS)								

Comments:

Data Quality Form: Completeness **Quality Control Session**

Monitoring Site	Type of Session (field or lab)
Your Name	Quality Assurance Leader
Date	

Parameter	Collection Period	No. of Samples Anticipated	No. Valid Samples Collected and Analyzed	Percent Complete
Temperature ^{o} C				
Dissolved Oxygen (mg/L)				
pH standard units				
Conductivity (uS)				

Comments:

Data Quality Form: Precision Quality Control Session

Monitoring Group Name	Type of Session (field or lab)
Your Name	Quality Assurance Leader
Date	

Parameter/ units	Mean (x)	Standard Deviation (s.d.)	s.d./x	Precision Objective	Meet Objective? Yes or No	Corrective action planned	Date Corrective Action taken
Temperature ^{o}C							
Dissolved Oxygen mg/L							
pH standard units							
Conductivity (uS)							

Comments: